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there are many interesting forms growing there which do not occur in the waters of the New World.—WALTER T. SWINGLE, *Washington, D. C.*

#### EXPLANATION OF PLATE XXVII.

A view of Naples and Vesuvius, looking east from the summit of the Vomero, an encircling range of hills several hundred feet high. In the midst of the park which extends along the shore may be seen the buildings of the Zoological Station.

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BOTRYCHIUM TERNATUM SWARTZ, VAR. LUNARIOIDES  
(MICHX.) MILDE.<sup>1</sup>

(OSMUNDA BITERNATA Lamarck; B. BITERNATUM Underwood.)

I OFFER the following criticism for two reasons; first, because I cannot agree with Dr. Underwood in his attempt to reinstate Lamarck's species on characters so unreliable as those which he brings forward in his article on the "Rarer Ferns in Alabama;"<sup>2</sup> and second, because I consider it an error to credit Professor Eaton with Milde's combination, as he had nothing whatever to do with it. Again, Dr. Underwood is in error in saying that Professor Eaton "overlooked its very distinct leaf and bud characters"; on the contrary those characters were very carefully considered by Professor Eaton at the time he elaborated the species for his *Ferns of North America*. It was my privilege to be permitted to assist Professor Eaton on that portion of his work, and it was through my finding the Georgia specimen of true *lunarioides* in the Gray Herbarium that he was led to change his original treatment of the species. From this it will be seen that the character of the "leaf and bud" were well known to Professor Eaton and had received proper consideration.

But let us take up, one by one, all of the characters brought forward by Dr. Underwood, and see to what real importance they are entitled.

*First*, as to the character of the bud. He correctly states that "*B. ternatum* is characterized by its hairy bud," but when he adds "while the bud of *B. biternatum* is smooth," the statement requires some qualification, for in all of the specimens of *lunarioides* in my own private

<sup>1</sup> Read before the New England Botanical Club, April 2, 1897.

<sup>2</sup> BOT. GAZ. 22: 407. 1896.

collection, and in those in the Davenport Herbarium (Mass. Hort. Soc.), the bud is pilose, and this was true also of the duplicates which I distributed some years ago. Of what value then is an occasional smooth bud except to show that here, as elsewhere, mere pubescence is a variable and unreliable character of no specific importance whatever? The fact is that a similar difference of degree exists in the vestiture of the buds of *B. ternatum* and its var. *lunarioides* as that which exists between the buds of *B. Virginianum* and its var. *gracile*, and we might with equal force contend for the reestablishment of Pursh's species on this ground. In large forms of *B. Virginianum* the bud is usually very shaggy, while in the small forms it is apt to be scantily clothed, and sometimes quite smooth. A similar variation may be found in the buds of *B. ternatum* and its many forms, some being very shaggy, others less so, or only sparingly clothed, or even, as in my specimens from Sweden, nearly smooth. This, it seems to me, effectually disposes of any argument based on the mere presence or absence of pubescence on the bud.

*Second*, as to "its very distinct leaf." New England botanists who have collected *ternatum* in any quantity know very well that the different varieties merge into one another by almost imperceptible gradations through a great variety of forms, nearly all of which may be found in a series of specimens of the var. *dissectum* alone, thus showing that the mere cutting of the lamina and its consequent differently shaped segments has no specific importance whatever as a basis for separation. Even in individual plants, where the frond of a previous year's growth remains attached, marked differences in the form of the divisions may be found, and I have three fronds taken from one plant in different years that might be taken for different plants by any one not knowing their origin. There are also marked differences in the ultimate segments of individual plants of *lunarioides* itself. I doubt if anyone has seen, or has had pass through his hands, a greater number of these plants, or from a wider range than I have during the past twenty years, and I greatly prefer the comprehensive treatment which Milde gave to this species to any treatment that would break it up into as many species as there are forms. I recognize certain centers of variation, to one or the other of which the different forms can be referred, but it is not possible to separate them into distinct species, as Prantl has attempted to do, without incurring the risk of endless confusion.

*Third*, as to the relative position of the sterile and fertile divisions

of the frond. An examination of a large suite of specimens of *ternatum* and its forms, from a range extending throughout New England, Canada, Alaska, Washington, California, and Mexico, as well as Georgia, South Carolina, Florida, Virginia, and the Middle States, shows that the length of the stalk of the sterile division of the frond is no less variable than are the other characters mentioned, and varies all the way from one-half an inch to six or eight inches or more. In plants from Alaska and Washington, the stalk is generally very short, sometimes not over three-eighths of an inch long, while in a specimen of true *lunarioides* from Florida (Chapman) in the Gray Herbarium the stalk is three-fourths of an inch long, and it is more than probable that if we could get as large a number of specimens of *lunarioides* as we do of the other forms we should find an equal degree of variation in the length of the stalk. Dr. Milde's tables of measurements for the different forms of this species show how extremely variable and unreliable this character is.

*Fourth*, as to its habitat, concerning which little need be said. It is not an uncommon thing to find typical *ternatum* growing in dry soil on high ground as well as in low moist woodlands and swamps. Only last August (1896) I found a fine plant of it growing on a very shallow grassy knoll on top of a granite ledge!

*Fifth*, as to the spores, the most important of all characters in the botrychiums. Here, as elsewhere, I fail to find any differences to justify specific recognition. An examination of the spores from my Alabama and European specimens shows less difference between the spores of these two forms from such widely separated regions than there is between the spores of the individual plants themselves. In fact they are identical in shape and marking. Neither can I detect any marked distinction between the spores of plants from New England, Canada, Alaska, Washington, California, and Mexico. On the contrary, in all of the forms of *ternatum* which I have examined, the spores of individual plants vary in shape, some being reniform, some pyriform, others oval or egg-shaped, and some even with irregular curved outlines, but the markings appear uniformly the same in all. My examinations have been made with a Leitz  $\frac{1}{2}$  immersion objective, and the result shows conclusively that absolutely one type of spore runs through all forms of *ternatum*.

*Sixth*, concerning the time of perfecting spores, unfortunately, the evidence is incomplete, as we have no knowledge of the fruiting time

of *lunarioides* in its more northern latitude. There are, however, some data bearing on the question that lead me to believe that the early fruiting of Alabama plants may be explained naturally without resorting to specific recognition. Milde credits *lunarioides* to Lake Superior (*Macoun*) and Montreal (*Watt*) in Canada, and I cannot believe it possible for him to have been mistaken in any specimens coming under his personal observation. Dr. Watt's specimens I have not seen, but I do not find any true *lunarioides* among the plants which Professor Macoun has very kindly sent to me for examination. His specimens are nearly all identical with the European *rutaceum*, but I am of the opinion that he must have sent *lunarioides* to Milde at some time, or the latter would not have vouched for it. It is not improbable, therefore, that if we had more reliable data it would be found that *lunarioides* in a more northern latitude would mature spores well on into June or July. One thing is certain, however, and that is that the fruiting time of *ternatum* and its forms, throughout its northern latitudes, ranges all the way from June to October, and it is not surprising that in tropical or semitropical climates its range should begin earlier and last longer. It is certain also that a difference of time exists even in the same latitudes between different and even the same forms according to the situations in which they grow. Thus, on Mt. Desert, according to Mr. Rand, normal *ternatum* growing on mountain tops perfects spores in July, while in the woodland swamps at the base of the same mountains it does not mature spores until late in September. In 1879 Dr. Charles Mohr very kindly sent to me a generous supply of *lunarioides*, at the same time calling my attention to its early fruiting, his specimens being collected in March, and the matter was fully considered by Professor Eaton and myself, with the conclusion that this was not in itself of more than varietal importance, and that Milde's disposition of the plant was correct. Nearly all of the specimens which I received from Dr. Mohr had a frond of an earlier growth remaining, and the weather beaten fertile panicle of the older frond had discharged all of its spores, while the panicles on the fresh fronds were only partially developed and the sporangia were immature, and now look as if they would not have been ready to discharge spores for some time longer, perhaps not until well into April; certainly not very remarkable for a southern species that in the north sometimes matures spores in June! On this point Dr. Mohr writes me that the Alabama season extends from January to the middle of April.

But even conceding the importance claimed for this habit of early fruiting, it is still only one point of six left open for consideration, and we may sum up all the characters of *lunarioides* that we have been reviewing as follows:

1. *The bud*: Commonly pubescent, of varying degrees, only rarely smooth; character not of specific value.
2. *The lamina*: Its cutting and shape of the segments; character wholly unreliable, or of varietal importance only.
3. *Relative position of the sterile and fertile divisions*: Sterile division nearly sessile, or short-stalked; scarcely of more than varietal significance.
4. *Habitat*: Character variable and unimportant.
5. *Spores*: Shapes and markings as in the other forms (including type); no specific differences.
6. *Fruiting time*: Evidence incomplete and inconclusive, and doubtfully of more than varietal significance at the most.

My conclusion, therefore, is that Lamarck's *Osmunda biternata* had best remain where Milde placed it, under *B. ternatum* as a good variety.

But here arises another question which it may be well to consider briefly. There is a tendency on the part of some of our later authorities to give to well marked varieties specific recognition, on the ground that it facilitates scientific investigation; and since, at the best, species are merely the arbitrary definitions devised by man for the convenience of study, there would be no serious objection to this if it were not for the numerous intermediate forms that constantly confront us and demand recognition. It is all very well to say that such forms may be disregarded for purposes of classification, but we cannot dispose of them in that way. They are an essential part of Nature's great scheme of evolution, and just as much entitled to recognition as more definite forms. I have known collectors who were in the habit of throwing to one side all puzzling forms that could not be placed readily, so as not to disturb the arrangement of species in their collections, but no close student of nature would be content with such practices. Nature shows little sympathy for our conceptions of species; she deals with large groups, orders, races, and the nearer we approach to her methods the more accurate will our knowledge of her great works become. It is for this reason, therefore, that I prefer that broader recognition of the

limitations of a species which provides for all intergrading forms and their variations.

A list of the material used in my examinations may be of interest, as showing the extensive range and cosmopolitan character of this species.

1. Specimens, including all forms, from various parts of New England, from my own collections and those of John Robinson, Walter Deane, Mr. Pringle, and others; beside which I have had access at various times to the fine collections of Professor Eaton, Mr. Faxon, and the especially valuable collection (now in possession of the Appalachian Mountain Club) of the late Mr. E. H. Hitchings; to say nothing of the numerous specimens which I have identified, from time to time, for various collectors and correspondents.

2. Specimens from New York and the Middle States, from the collections of Mrs. Barnes, Rust, Myers, Gifford, and other members of the Syracuse Botanical Club; also collections of E. S. Miller (Long Island), J. H. Redfield (Pennsylvania), Dr. Schneck (Illinois), and others. One of Mrs. Barnes' North Woods plants is remarkable for the small, rounded, almost lunate segments (as in Alabama plants), and the very nearly sessile sterile divisions, the stalk of which is shorter than in Chapman's Florida specimen. Between this and her larger plants, that approximate Californian *australe*, there is every conceivable variation.

3. Specimens from Canada: Prince Edwards Island, north shore of Lake Superior, Northwest Territory and British Columbia, from the collections of Professor Macoun.

4. Specimens from Alaska (*Turner*), Washington (*Suksdorf*), California (*Miller*), and Mexico (*Pringle*).

5. Specimens of *lunarioides* from Georgia (original specimen figured in Eaton's *Ferns of North America*), in Gray Herb.; Florida (*Chapman*, in Gray Herb.); South Carolina, in Herb. Mass. Hort. Soc., donated by Redfield; Alabama, in Herb. Mass. Hort. Soc. and my private collection, from Dr. Mohr. In all of these specimens the bud is pilose.

6. Specimens from New Zealand, in Gray Herb.; Japan (*Oldham*, and a specimen collected by Ångström), in Gray Herb.; also specimens from Sweden in my own collection.—GEORGE E. DAVENPORT, *Medford, Mass.*